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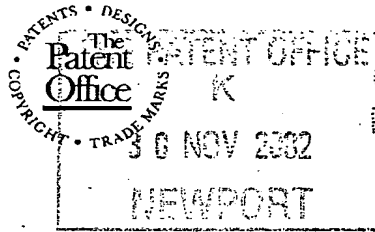


Signed

He Behen

Dated 23 October 2003





1/77
0228003.0
30 NOV 2002

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

A10753GB-GMD/scf

2. Patent application number

(The Patent Office will fill in this part)

0228003.0

30 NOV 2002

3. Full name, address and postcode of the or of each applicant (*underline all surnames*)

Honeywell Normalair-Garrett (Holdings) Limited
Yeovil
Somerset
BA20 2YD

Patents ADP number (*if you know it*)

7937918001

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention Control of Temperature of supply of Pressurised Air

5. Name of your agent (*if you have one*)

Forrester Ketley & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent (*including the postcode*)

Chamberlain House
Paradise Place
Birmingham
B3 3HP

Patents ADP number (*if you know it*)

133005 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (*if you know it*) the or each application number

Country

Priority application number
(*if you know it*)

Date of filing
(*day / month / year*)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(*day / month / year*)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (*Answer 'Yes' if:*

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

See note (d))

Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

5

Claim(s)

2

Abstract

1

Drawing(s)

1

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

Forrester Kelley & Co.

Date

29 November 2002

Forrester Kelley & Co.

12. Name and daytime telephone number of person to contact in the United Kingdom

Graham Dodd
0121 236 0484

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Notes

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PATENTS ACT 1977

A10753GB-GMD

Title: Control of Temperature of Supply of Pressurised Air

Description of Invention

5 This invention relates to a method of, and apparatus for, controlling the temperature of pressurised air supplied from a source thereof to a system or device which makes use of it.

 The invention has been devised in the context of the supply of bleed air from at least one gas turbine engine of an aircraft. It is known to use bleed air
10 from a gas turbine engine (i.e. air taken from the flow of air through the engine after a compressor stage of the engine and thus pressurised) in ancillary systems of the aircraft such as an air conditioning system for example. A further example where bleed air might be used in an aircraft is a system for oxygen separation using a pressure swing adsorption process, to provide an oxygen or
15 oxygen-enriched supply for breathing by crew or other persons on board the aircraft.

 Some systems such as pressure swing adsorption systems for oxygen separation are particularly sensitive to variations in the temperature of pressurised air with which they are supplied, and the temperature must be
20 controlled within relatively narrow limits if the system is to perform satisfactorily. Bleed air as supplied from an aircraft engine(s) is usually at a higher temperature than that required, and consequently needs to be cooled which is usually accomplished by passing the bleed air through a heat exchanger which puts it in heat exchange relationship with a coolant fluid. The
25 cooling effect of a heat exchanger depends on the difference in temperature between the fluid which is being cooled and the coolant fluid, and on the flow rates of the two fluids. Often the coolant is ram air, i.e. ambient air which is caused to pass through the heat exchanger as a result of the aircraft's forward movement and it will be appreciated that in this case the temperature and flow

rate of the coolant air can vary substantially: such variations result in variations in the temperature of the bleed air after it has passed through the heat exchanger. If the coolant is ram air, none is provided if the aircraft is not moving.

5 There are known ways to control the temperature of the bleed air as it is delivered from the heat exchanger. For example there is the technique known as "bleed air bypass", in which some of the bleed air bypasses the heat exchanger and is mixed with the bleed air which has passed through the heat exchanger, downstream of the heat exchanger, under the control of a
10 temperature-responsive valve. Another technique is to modulate the flow of the coolant by a suitable valve provided in the path of coolant flow. Either of these techniques introduces inefficiencies by impeding the flow of the bleed air or coolant as the case may be, or by wasting the air.

 Accordingly it is the object of the present invention to provide for
15 controlling the temperature of supply of pressurised air in a manner which does not introduce such inefficiencies.

 According to one aspect of the present invention, we provide a method of controlling the temperature of pressurised air supplied from a source thereof; comprising passing the pressurised air through a heat exchanger wherein it is in
20 heat-exchange relationship with coolant air, flow of the coolant air through the heat exchanger being caused to take place by an ejector device using some of the pressurised air; characterised by controlling the supply of the pressurised air to the ejector device in accordance with the temperature of the pressurised air downstream of the heat exchanger.

25 In a method in accordance with the invention, the flow of coolant air is controlled by controlling the supply of pressurised air to the ejector device. Only as much of the supply of the pressurised air is used to power the ejector device as is necessary in view of the temperature of the pressurised air

downstream of the heat exchanger. Waste of the pressurised bleed air is reduced.

The temperature of the pressurised air downstream of the heat exchanger may be measured and compared, by a control means, with a desired temperature, the control means providing an output signal to vary the setting of a valve to increase or decrease the flow to the ejector, when the temperature of the pressurised air deviates from the desired value.

According to another aspect of the invention, we provide apparatus for controlling the temperature of pressurised air supplied from a source thereof; comprising a heat exchanger through which the pressurised air is passed and brought into heat exchange relationship with coolant air; an ejector device supplied with some of the pressurised air and operable to induce flow of the coolant air through the heat exchanger; means for measuring the temperature of the pressurised air downstream of the heat exchanger; and control means operable to control the supply of the pressurised air to the ejector device in accordance with the measured temperature of the pressurised air downstream of the heat exchanger.

The invention may utilise a modulating valve of any suitable type disposed in a conduit leading the bleed air to the ejector device.

The accompanying drawing diagrammatically illustrates the invention.

In the drawing, pressurised bleed air is supplied along a conduit 10 from an aircraft gas turbine engine or engines, either a main engine(s) or that of an auxiliary power unit. The bleed air supply is pressure/flow regulated upstream of the conduit 10, so the supply is stable in respect of its pressure. Having been compressed, the bleed air will be hot and for use in, for example, an oxygen separation system of the pressure swing adsorption type, is required to be cooled and supplied at a temperature controlled within relatively close limits. To this end the bleed air is passed through a heat exchanger 11, which may be of cross-flow or counter-flow type, in which it is brought into heat exchange

relationship with a coolant flow of air reaching the heat exchanger along conduit 12. Downstream of the heat exchanger, the pressurised bleed air is delivered by a conduit 13 to the system or device where it is to be used.

From the conduit 10, some of the pressurised bleed air is able to be delivered by way of a conduit 14 to an ejector device 15 in which flow of the partial quantity of the bleed air is used to induce a flow of the coolant air through the heat exchanger, a duct 16 for the coolant air leading from the heat exchanger to the ejector device. Ejector devices, in which flow of a first fluid in a suitably shaped passage or nozzle is used directly to induce flow of a second fluid without any intervening mechanical parts, are well known and will not therefore be described in detail. The flow rate of the second fluid varies dependant on the flow rate of the first fluid supplied to the ejector device.

In the conduit 14 there is provided a valve 17, which is a modulating valve of any suitable type, e.g. rotary or linear, and whose operation is controlled, e.g. electrically or pneumatically, from a control means 18. A temperature sensor is indicated at 19 for measuring the temperature of the bleed air in the conduit 13, and the sensor 19 produces an output signal which is supplied to the control device 18. The control means 18 compares the measured temperature with a required temperature for the air in the conduit 13, and provides a signal to the valve 17 to increase or decrease the flow of bleed air supplied to the ejector 15, and hence the flow of coolant air through the heat exchanger 11, in accordance with the temperature comparison aforesaid. Hence the temperature of the air in the conduit can be kept as close as possible to the required value.

In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process

for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A method of controlling the temperature of pressurised air supplied from a source thereof; comprising passing the pressurised air through a heat exchanger wherein it is in heat-exchange relationship with coolant air, flow of the coolant air through the heat exchanger being caused to take place by an ejector device using some of the pressurised air; characterised by controlling the supply of the pressurised air to the ejector device in accordance with the temperature of the pressurised air downstream of the heat exchanger.
2. A method according to Claim 1 comprising measuring the temperature of the pressurised air downstream of the heat exchanger, comparing such measured temperature with a desired temperature, and providing an output signal to cause the supply of the pressurised air to the ejector to be varied when the measured temperature deviates from the desired value.
3. Apparatus for controlling the temperature of pressurised air supplied from a source thereof; comprising a heat exchanger through which the pressurised air is passed and brought into heat exchange relationship with coolant air; an ejector device supplied with some of the pressurised air and operable to induce flow of the coolant air through the heat exchanger; means for measuring the temperature of the pressurised air downstream of the heat exchanger; and control means operable to control the supply of the pressurised air to the ejector device in accordance with the measured temperature of the pressurised air downstream of the heat exchanger.
4. Apparatus according to Claim 3 wherein the control means is operable to compare the measured temperature of the pressurised air with a desired temperature, and to provide an output signal to control the supply of pressurised

air to the ejector device in accordance with deviation of the temperature of the pressurised air from the desired value.

5. Apparatus according to Claim 3 or Claim 4 comprising a modulating valve means disposed in a conduit supplying the pressurised air to the ejector device and receiving the output signal from the control means.

6. An aircraft having apparatus according to any one of claims 3 to 5 for controlling the temperature of bleed air supplied from at least one gas turbine engine of the aircraft.

7. A method of, or apparatus for, controlling the temperature of pressurised air supplied from a source thereof, substantially as hereinbefore described with reference to and/or as shown in the accompanying drawing.

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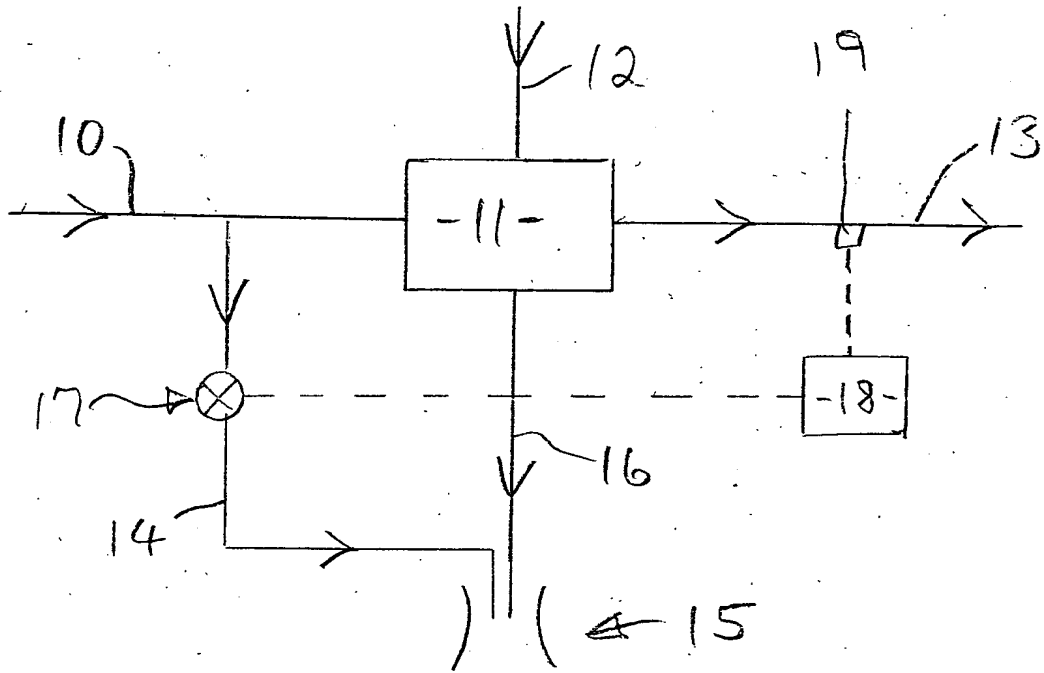
8. Any novel feature or novel combination of features described herein and/or in the accompanying drawing.

ABSTRACT

Title: Control of Temperature of Supply of Pressurised Air

5 A method of, and apparatus, for, controlling the temperature of
pressurised air such as bleed air from a gas turbine engine, wherein the air is
passed through a heat exchanger to exchange heat with coolant air which is
caused to flow through the heat exchanger by operation of an ejector device
powered by some of the pressurised air, the supply of the pressurised air to the
10 ejector being controlled to control the flow of coolant air and hence control the
temperature of the pressurised air downstream of the heat exchanger.

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